

CREATING A GEOREFERENCED DIGITAL IMAGE LIBRARY OF EUROPA. Z. A. Crawford¹, R. T. Pappalardo¹, G. C. Collins², ¹Laboratory for Atmospheric and Space Physics (LASP), University of Colorado at Boulder, UCB 392, Boulder CO, 80309 (zane.crawford@colorado.edu, robert.pappalardo@colorado.edu), ²Physics and Astronomy Department., Wheaton College, Norton, MA 02766 (gcollins@wheatonma.edu).

Introduction: Geographic Information Systems (GIS) software has been used extensively in Earth-based quantitative mapping as the means for tying computational models to field and satellite observations of the surface. However, it has not yet become the standard method of mapping and manipulating geographic data in extraterrestrial settings. Currently, mapping is commonly done on a frame-by-frame basis in applications unaware of georeferencing, making large-scale generalizations and data-sharing between research groups difficult.

In the hopes of reducing duplicated efforts, enhancing collaboration between researchers, and facilitating quantitative geological analyses, we are creating a digital library of the Galileo SSI images of Europa which are processed uniformly, and consistently georeferenced so as to be ready for use in several popular GIS software packages (e.g. ESRI's ArcGIS 8.3)

Processing Methodology: We begin with the planetary data system (PDS) imaging archives and use the USGS Integrated Software for Imagers and Spectrometers (ISIS) to update pointing and calibrate the images. Bad lines and ragged edges are removed. The corrected USGS 1 km Europa basemap defines the coordinate system and hence our georeferencing. We manually tie higher resolution images to the basemap images in order to ensure consistent positioning. Using only the spacecraft pointing data, positioning errors of tens of km exist in high resolution images. We plan to make the images available on the internet and to the PDS both as ISIS cubes and as projected, georeferenced TIFF files.

Potential Applications: With correctly georeferenced images and a capable GIS software package, it is simple to measure true distances, areas, and orientations regardless of the map projection used. Mapped features can be output in a digital format and their content analyzed quantitatively in comparison with predictions made by computational models.

Computer-assisted stratigraphic sorting: It is essential that mapping of structures on Europa be performed in GIS for the following reasons. First, the feature locations and orientations will then be inherently referenced to the coordinate system of the body. Second, the resulting structures map will exist in the form of a database, which can be searched and shared, and on which quantitative analyses can be performed. Third, ancillary information about each structure (e.g., morphology) can be stored within the database. Finally, the enormous number of structures to be analyzed on Europa demands that we take a database approach to

analyzing the data if we are to make significant progress in understanding their patterns, relationships, stratigraphy, and origins.

One analysis the database will allow is the sorting of lineaments by age. Even when the stratigraphic relationships are locally clear, there is too much data to comprehend if one looks at a broad region. As a result, manual stratigraphic sorting of the structures within the database is possible [1], but slow and errorprone.

We are developing a GIS module to assist the stratigraphic sorting process, by tracking each local stratigraphic relationship as input by the user, then sorting the resulting database to produce the sequence of structures that best matches the observations. These techniques can also be applied Ganymede, Callisto, and other planetary bodies.

Correlating surface stresses and lineaments: Non-synchronous rotation and diurnal tidal stresses contribute to a stress pattern that affects the surface of Europa, each on a very different time scale. Over the 85-hour orbital period, the diurnal stress pattern acts on the surface, with a maximum magnitude of ~40 kPa [2]. The nonsynchronous stress pattern sweeps over the surface due to a slow rotation of the icy shell over the tidally locked interior of the moon, and occurs with a period of >10,000 years [3]. Polar wander (reorientation of the icy shell with respect to the axis of rotation) may also contribute to the surface stress pattern on Europa [4]. These three candidate stress mechanisms can combine additively.

In order to compare the observed pattern of lineaments with many possible combinations of these stress fields as calculated by quantitative stress modeling [5], we will use a computer to aid in the comparisons, and determine the parameter space in which the best fits lie. For this to work lineament mapping must be performed with a consistent coordinate system across the globe, thus making digital mapping far preferable to mapping without GIS.

References: [1] McBee and Collins (2002) LPSC XXXIII abstract #1449. [2] Hoppa et al. (1999a) *Science*, 285, 1899-1902. [3] Hoppa et al. (1999) *Icarus*, 137, 341-347. [4] Leith and McKinnon (1996) *Icarus*, 120, 387-398. [5] Stempel and Pappalardo (2003)